

What is Claimed is:

1. A method for attaching a first component which comprises a depending portion to a second component which comprises a bore that is sized and configured to receive the depending portion, the first and second  
5 components being exposed to a fluid which is at an ambient pressure, the method comprising the steps of:  

inserting the depending portion at least partially into the bore; and  
creating a bore pressure within the bore which is less than the  
ambient pressure;

  
10                wherein a pressure difference between the ambient pressure and the bore pressure will force the depending portion into the bore to thereby attach the first component to the second component.
2. The method of claim 1, further comprising the step of providing a seal on at least one of the depending portion and the bore.
- 15        3. The method of claim 2, wherein the inserting step comprises the step of inserting the depending portion into the bore until the seal engages both the depending portion and the bore.
4. The method of claim 1, wherein the pressure creating step comprises the step of removing at least a portion of the fluid from the bore.
- 20        5. The method of claim 4, wherein the fluid removal step comprises the steps of:  

providing a fluid conduit which extends through at least one of the  
first and second components and communicates with the bore; and

removing the fluid through the fluid conduit.

6. The method of claim 5, wherein the fluid removal step further comprises the steps of:

providing a vacuum means; and

5 fluidly connecting the vacuum means to the fluid conduit.

7. The method of claim 6, wherein the vacuum providing step comprises the step of providing a self-contained vacuum means which is sufficiently light weight to be carried by an ROV.

8. The method of claim 1, further comprising the step of mechanically  
10 locking the first component to the second component.

9. The method of claim 8, wherein the locking step comprises the steps of:

providing a locking profile on at least one of the first and second components;

15 providing a lockdown ring and a lockdown piston on the other of the first and second components; and

actuating the lockdown piston into engagement with the lockdown ring to force the lockdown ring into engagement with the locking profile.

10. The method of claim 9, wherein the actuating step comprises the  
20 step of:

creating a pressure within a volume adjacent the lockdown piston which is less than the ambient pressure;

wherein the ambient pressure will force the lockdown piston into engagement with the lockdown ring.

11. The method of claim 10, wherein the pressure creating step comprises the steps of:

5                    providing a fluid conduit which extends through at least one of the first and second components and communicates with the volume adjacent the lockdown piston; and

                    removing the fluid within the volume through the fluid conduit.

12. The method of claim 11, wherein the fluid removal step further  
10 comprises the steps of:

                    providing a vacuum means; and

                    fluidly connecting the vacuum means to the fluid conduit.

13. The method of claim 12, wherein the vacuum providing step comprises the step of providing a self-contained vacuum means which is  
15 sufficiently light weight to be carried by an ROV.

14. An apparatus for attaching a first component which comprises a depending portion to a second component which comprises a bore that is sized and configured to receive the depending portion, the first and second components being exposed to a fluid which is at an ambient pressure, the  
20 apparatus comprising:

                    a fluid conduit which extends through at least one of the first and second components and communicates with the bore; and

means in fluid communication with the fluid conduit for removing at least a portion of the fluid from the bore;

wherein when the depending portion is inserted at least partially into the bore, the fluid removing means will create a bore pressure within the  
5 bore which is less than the ambient pressure; and

wherein a pressure difference between the ambient pressure and the bore pressure will force the depending portion into the bore to thereby attach the first component to the second component.

15 15. The apparatus of claim 14, further comprising a seal which is mounted on at least one of the first and second components and is adapted to seal between the depending portion and the bore.

16. The apparatus of claim 14, wherein the fluid removing means comprises a vacuum pump.

15 17. The apparatus of claim 16, wherein the vacuum pump is mounted on a suction tool which is sufficiently lightweight to be carried by an ROV.

18. The apparatus of claim 16, further comprising means for actuating the vacuum pump.

19. The apparatus of claim 18, wherein the actuating means comprises a hydraulic pressure source.

20 20. The apparatus of claim 19, further comprising means for communicating the hydraulic pressure source to the vacuum pump.

21. The apparatus of claim 20, wherein the communicating means comprises a hot stab manifold which is fluidly connected to the vacuum pump.

22. The apparatus of claim 19, wherein the hydraulic pressure source is mounted on an ROV which includes a hot stab that is adapted to be received in the hot stab manifold to thereby fluidly connect the hydraulic pressure source to the vacuum pump.

5 23. The apparatus of claim 16, further comprising:

a hot stab bore which is in fluid communication with the fluid conduit; and

a hot stab which is fluidly connected to the vacuum pump;

10 wherein the hot stab is adapted to be received in the hot stab bore to thereby fluidly connect the vacuum pump to the fluid conduit.

24. The apparatus of claim 14, further comprising means for selectively opening and closing the fluid conduit.

25. The apparatus of claim 24, wherein the opening and closing means comprises a needle valve.

15 26. The apparatus of claim 25, wherein the needle valve may be actuated by an ROV.

27. The apparatus of claim 14, further comprising means for locking the first component to the second component.

28. The apparatus of claim 27, wherein the locking means comprises:  
20 a locking profile which is located on one of the first and second components;

a lockdown ring which is positioned on the other of the first and second components and is adapted to engage the locking profile to thereby lock the first component to the second component.

29. The apparatus of claim 28, further comprising:

5 a lockdown piston which is positioned on the other of the first and second components adjacent the lockdown ring; and

means for actuating the lockdown piston into engagement with the lockdown ring to force the lockdown ring into engagement with the locking profile.

30. The apparatus of claim 29, wherein the actuating means comprises  
10 the removing means.

31. The apparatus of claim 30, further comprising;

a second fluid conduit which extends through at least one of the first and second components and communicates with a volume adjacent the lockdown piston;

15 wherein the removing means is selectively fluidly connectable to the second fluid conduit to thereby create a pressure within the volume adjacent the lockdown piston which is less than the ambient pressure; and

wherein the ambient pressure will force the lockdown piston into engagement with the lockdown ring.

20 32. An apparatus for attaching a tree cap which comprises a depending seal plate to a subsea christmas tree which comprises a bore that is sized and configured to receive the seal plate, the tree cap and the christmas

tree being exposed to a surrounding fluid which is at an ambient pressure, the apparatus comprising:

a fluid conduit which extends through at least one of the tree cap and the christmas tree and communicates with the bore; and

5 means in fluid communication with the fluid conduit for removing at least a portion of the fluid from the bore;

wherein when the seal plate is inserted at least partially into the bore, the fluid removing means will create a bore pressure within the bore which is less than the ambient pressure; and

10 wherein a pressure difference between the ambient pressure and the bore pressure will force the seal plate into the bore to thereby attach the tree cap to the christmas tree.

33. The apparatus of claim 32, further comprising a seal which is mounted on at least one of the tree cap and the christmas tree and is adapted to  
15 seal between the seal plate and the bore.

34. The apparatus of claim 32, wherein the fluid removing means comprises a vacuum pump.

35. The apparatus of claim 34, wherein the vacuum pump is mounted on a suction tool which is sufficiently lightweight to be carried by an ROV.

20 36. The apparatus of claim 34, further comprising means for actuating the vacuum pump.

37. The apparatus of claim 36, wherein the actuating means comprises a hydraulic pressure source.

38. The apparatus of claim 37, further comprising means for communicating the hydraulic pressure source to the vacuum pump.

39. The apparatus of claim 38, wherein the communicating means comprises a hot stab manifold which is fluidly connected to the vacuum pump.

5        40. The apparatus of claim 39, wherein the hydraulic pressure source is mounted on an ROV which includes a hot stab that is adapted to be received in the hot stab manifold to thereby fluidly connect the hydraulic pressure source to the vacuum pump.

41. The apparatus of claim 34, further comprising:  
10        a hot stab bore which is in fluid communication with the fluid conduit; and  
          a hot stab which is fluidly connected to the vacuum pump;  
          wherein the hot stab is adapted to be received in the hot stab bore to thereby fluidly connect the vacuum pump to the fluid conduit.

15        42. The apparatus of claim 32, further comprising means for selectively opening and closing the fluid conduit.

43. The apparatus of claim 42, wherein the opening and closing means comprises a needle valve.

44. The apparatus of claim 43, wherein the needle valve may be  
20        actuated by an ROV.

45. The apparatus of claim 32, further comprising means for locking the tree cap to the christmas tree.

46. The apparatus of claim 45, wherein the locking means comprises:



a locking profile which is located on one of the tree cap and the christmas tree;

a lockdown ring which is positioned on the other of the tree cap and the christmas tree and is adapted to engage the locking profile to thereby lock  
5 the tree cap to the christmas tree.

47. The apparatus of claim 46, further comprising:

a lockdown piston which is positioned on the other of the tree cap and the christmas tree adjacent the lockdown ring; and

means for actuating the lockdown piston into engagement with the  
10 lockdown ring to force the lockdown ring into engagement with the locking profile.

48. The apparatus of claim 47, wherein the actuating means comprises the removing means.

49. The apparatus of claim 48, further comprising;

a second fluid conduit which extends through at least one of the  
15 tree cap and the christmas tree and communicates with a volume adjacent the lockdown piston;

wherein the removing means is selectively fluidly connectable to the second fluid conduit to thereby create a pressure within the volume adjacent the lockdown piston which is less than the ambient pressure; and

20 wherein the ambient pressure will force the lockdown piston into engagement with the lockdown ring.